L-SHAPED TEOS GAS INJECTOR FOR LPCVD TEOS WITHIN-WAFER UNIFORMITY IMPROVEMENTS

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The invention relates to the fabrication of integrated circuit devices, and more particularly, to a apparatus for more closely matching the uniformity of thickness of TEOS spacers for wafers that are processed in a vertical LPCVD TEOS furnace.

(2) Description of the Prior Art

In the manufacturing of semiconductor devices, it is from a cost point of view advantageous and therefore required that wafers are simultaneously processed in relatively large numbers (or batches). For this processing the wafers are inserted into wafer holders or boats after which a particular processing step is performed that equally applies to all wafers that are contained in the boat. The processing of semiconductor devices frequently implies that wafer surfaces are exposed to chemicals. In order to assure uniformity of processing and uniformity of the semiconductor devices that are created in this manner, it is required that all devices that are contained on surfaces of all the wafers that are loaded into the boat are equally exposed and

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treated. This implies that chemicals or other substances that are used in the creation of semiconductor devices must affect the surfaces where these devices are created under essentially the same processing conditions of temperature, pressure, chemical concentration, gas flow rates, angle of impact, and the like. The processing of the wafer that are contained in the boat most frequently occurs be introducing the boat into a processing environment, which in most cases is a processing chamber that is specifically designed for a particular processing step. As an example can be cited the use of a reactor chamber where a reactive gas, for instance SiH_4 or Si_2H_6 can be introduced into the chamber at a particular flow rate, for instance a flow rate of 0.01 to 1.0 cc/minute, a dopant can be added to the gas such as boron or phosphorous. The reactor chamber can also be a low pressure system with a SiC tube or quartz tube, whereby the work piece can be exposed in the reaction chamber dependent on the film thickness that is required for a period of time within the range of for instance between 1 and 10 hours while a voltage can be applied to the electrodes of the chamber within the range of for instance between 0 and 20 volts.

A great deal of attention has been paid in the industry to the methods that can be employed in cleaning processing chambers, particularly as this applies to the cleaning of etch chambers. A

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method for controlling the progress of the etch chamber cleaning process is the so-called end point detection. Using this method the cleaning process is stopped when all of the materials that previously have been deposited on the wall of the chamber have been removed. Optical Emission Spectroscopy (OES) enables the monitoring of the intensity of an emission signal that is characteristic of one of the cleaning byproducts. This method however can only be effective if the inside walls of the etch chamber are made of materials that do not interfere with this process of material identification. Laser induced fluorescence also allows for the monitoring of the composition of the gas adjacent to the etched layer for the absence of or for the substantially reduced concentration of the etched material or any of its known components.

As another example of processing chambers can be mentioned the use of a sputter chamber that is used for the deposition of a seed layer that is frequently applied prior to depositing a layer of metal within an opening in a dielectric. The processing conditions for the deposition of the seed layer are, using a sputter chamber or an Ion Metal Plasma (IMP) chamber, at a temperature of between about 0 and 300 degrees C. and a pressure of between about 1 and 100 mTorr, using copper or a copper alloy

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as the source for the seed layer at a flow rate of between about 10 and 400 sccm and using argon as an ambient gas.

Yet one more example of the use of processing chambers, an example that applies more directly to the current invention, is used for the deposition of a layer of insulating material containing TEOS using TEOS as the source at a flow rate between about 100 and 300 sccm, a temperature between about 650 and 730 degrees C., a pressure between about 300 and 600 mTorr, time of deposition about 60 minutes whereby the processing chamber used is an LP system.

One of the frequently used materials in the creation of semiconductor devices is tetra-ethyl-ortho-silicate (TEOS). Conductors are typically isolated from each other and from underlying conductive elements by a suitable dielectric such as for instance but not limited to silicon dioxide ("oxide", doped or undoped) or silicon nitride ("nitride"), silicon oxynitride, fluoropolymer, parylene, polyimide, tetra-ethyl-ortho-silicate (TEOS) based oxides, boro-phosphate-silicate-glass (BPSG), phospho-silicate-glass (PSG), boro-silicate-glass (BSG), oxide-nitride-oxide (ONO), plasma enhanced silicon nitride (PSiNx), oxynitride. Also can be used a low dielectric constant material, such as hydrogen silsesquioxane or HDP-FSG (high-density-plasma

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fluorine-doped silicate glass), which is a dielectric that has a lower dielectric constant than regular oxide.

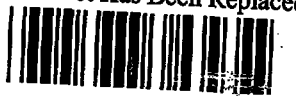
Where a first layer of oxide must be applied, material such as SiO_2, TEOS, Plasma Enhanced TEOS (PETEOS), boron phosphate and silicate glass (BPSG) can be used.

For the deposition of a layer of dielectric conventional deposition technology can be used, for instance, by using PECVD procedures at a temperature of between about 350 and 450 degrees C. to a thickness between about 5000 and 10,000 Angstrom using TEOS as a source.

Gate spacers that are typically formed on the sidewalls of MOSFET gate electrodes can use silicon nitride, silicon oxide, BSG, PSG, polysilicon, other materials preferably of a dielectric nature, CVD oxide formed from a TEOS source. Also, a layer of silicon dioxide can be deposited using TEOS as the silicon source in a parallel plate reactor.

A deposited layer of TEOS can be etched typically using CF_4 or CHF_3 as an etchant gas at a flow rate of about 15 sccm, a gas pressure of about 800 mTorr, rf power density about 400 Watts,

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with an ambient wafer temperature and a time of the etch of about 10 seconds.

The apparatus of the invention addresses the use of LPCVD chambers. Typical operating conditions for LPCVD chambers are a deposition temperature of between about 500 and 730 degrees C. and a pressure of between about 200 mTorr and 2 Torr. The apparatus of the invention addresses the deposition of TEOS, LPCVD chambers however are not limited to the deposition of TEOS. For instance, a layer of tungsten can be deposited using LPCVD processing, at a temperature between about 400 to 500 degrees C, to a thickness between about 6000 to 8000 Angstrom, using tungsten hexafluoride and silane as the source. A silicon oxide layer can be deposited using LPCVD processing at a temperature between 580 and 680 degrees C. to a thickness of for instance about 500 and 2500 Angstrom. An insulator can be deposited using LPCVD at a temperature between about 650 and 950 degrees C. to a thickness of for instance between about 1000 and 2000 Angstrom. Gate polysilicon can comprise in situ doped poly deposited using LPCVD at a temperature between about 500 and 700 degrees C. to a thickness between about 500 and 700 angstrom, using silane as a source and with the addition of phosphine to provide the needed dopant. Tungsten silicide can be deposited using LPCVD at a temperature between about 400 and 600 degrees C. to a thickness

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between about 750 and 1500 angstrom using tungsten hexafluoride and silane as a source. Silicon nitride (Si_3Ni_4) can be deposited using LPCVD using a reactant gas mixture such as dichlorosilane ($SiCl_2H_2$) and amonia (NH_3), typically deposited to a thickness of between 50 and 3000 angstrom. Insulating layers can contain borophosphosilicate glass (BPSG), deposited using LPCVD, using tetra-etho-siloxane (TEOS) as the reactant gas.

From the above examples it is clear that, although the invention specifically addresses the use of LPCVD for the deposition of TEOS, the use of the LPCVD process is widespread throughout the art and has numerous applications. LPCVD technology is frequently used to create thin films of amorphous and polycrystalline silicon that are widely used in semiconductor manufacturing. For example, amorphous silicon can be used for the formation at the gate of CMOS structures for application in the dual gate process since the amorphous silicon can effectively reduce the boron (B) penetration from the gate to the device region. Doped polycrystalline silicon can be used to form interconnects, gate electrodes, emitter structures and resistors. These silicon thin films are typically formed by LPCVD (low pressure chemical vapor deposition) by decomposition of a silicon gas such as silane (SiH_4) or disilane (Si_2H_6). Doping can also be accomplished in the gas phase by introducing a dopant gas such as

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diborane (B_2H_6), arsine (AsH_3) or phosphine (PH_3). The crystalline structure of the 'as deposited' film is largely a function of the deposition temperature of the LPCVD process. At temperatures below about 550 degrees C. the 'as deposited' films have an amorphous structure. At temperatures between about 550 degrees C. and 580 degrees C. there is a transition between amorphous silicon and polycrystalline silicon. Hemispherical grain (HSG) polysilicon is typically grown in this transitional range. At temperatures above about 580 degrees C. the 'as deposited' films have a polycrystalline structure.

The examples that have been indicated highlight the use of both LPCVD technology and the use of TEOS as a semiconductor manufacturing material that are widespread within the art. It is also well known that major semiconductor device improvements have in the past mostly been achieved by a continuous reduction in device dimensions. With this reduction in device dimensions, devices have shrunk to the sub-micron scale which results in the requirements that the thickness uniformity of the TEOS spacers becomes more critical since this uniformity has a direct effect on device performance, reliability and yield. Conventional LPCVD TEOS processing chambers apply the layer of TEOS using a vertical chamber whereby the TEOS gas flows into the reaction tube from the bottom of the tube being fed into the tube via a short horizontal

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injector. This results in gas concentrations that are not uniform in a vertical direction of the tube with a higher TEOS gas concentration at the bottom of the tube when compared with the top of the tube. This can be compensated for to some extend by controlling the TEOS gas temperature in a vertical direction of the tube in order to compensate for the depletion of the TEOS gas in the higher levels of the tube. This compensation is however only partially successful in reducing the thinning effect of the TEOS gas resulting in loss of within-wafer deposition uniformity of the TEOS layer. The wafer that is located in the upper section of the tube shows a noticeable reduction of deposition uniformity. The processing parameters that more significantly affect the within-wafer deposition uniformity are the localized pressure of the deposited TEOS and the processing temperature of the TEOS gas. The apparatus of the invention addresses the concerns of TEOS within-wafer deposition uniformity.

US 5,800,616 (Persyn) shows a vertical LPCVD furnace and L shaped injector (TEOS injection 80).

US 5,020,476 (Bayne et al.) shows a gas distribution system with primary and secondary injectors.

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US 6,053,430 (Wu et al.) shows a horizontal injector system for an oxidation furnace.

US 5,409,539 (Turner) shows a slotted diffusion furnace system.

US 5,178,534 (Bayne et al.) shows a furnace with another injection tube.

SUMMARY OF THE INVENTION

A principle objective of the invention is to provide an apparatus that allows for TEOS deposition whereby the deposition of the layer of TEOS is uniform across the surface of all wafers that are contained in a wafer-loading magazine.

Another objective of the invention is to reduce differences in TEOS deposition between layers that are loaded at different height within a wafer-loading magazine.

Yet another objective of the invention is to allow for creation of TEOS spacers of uniform thickness for all semiconductor devices that are created in the surface of a substrate by reducing gradation of TEOS deposition across the surface of a wafer that is contained in a wafer-loading magazine.

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In accordance with the objectives of the invention a new apparatus is provided for the deposition of one or more layers of TEOS. Where conventional vertical LPCVD TEOS furnaces feed the TEOS gas into the reaction tube at one point that is located at a lower extremity of the reaction tube, the apparatus of the invention provides an L-shaped TEOS gas injector that is provided with a multiplicity of openings around its circumference and extending in a longitudinal direction along the surface of the L-shaped gas injector. The longitudinal direction of the L-shaped gas injector is mounted parallel to the vertical direction of the TEOS reaction chamber. The apparatus of the invention therefore allows for an even distribution of the TEOS gas in a vertical direction of the reaction tube thus eliminating different conditions of processing for wafers that are stacked at different vertical levels within the vertical reaction tube.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a cross section of the LPCVD TEOS furnace of the invention wherein an extended and perforated TEOS gas injector has been mounted.

Fig. 2a and 2b show the conventional TEOS injector (Fig. 2a) and the TEOS injector (Fig. 2b) of the invention.

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Fig. 3 shows results that have been achieved by the implementation of the perforated TEOS gas injector of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In subjecting wafer surfaces to chemical exposures and treatments it is required, where this exposure is simultaneously applied to a larger number (batch) of wafers, that this exposure is uniform for all wafers that are contained within the batch and across the surface of each of the wafers that is contained within the batch of wafers. For this requirement to be met, it is basic that all conditions and materials that constitute these exposures and treatments are equally applied to each of the individual elements, such as semiconductor devices that are created in a surface of a substrate. Typically a batch of wafer will be simultaneously processed in a reaction chamber, a furnace or an oven. It is therefore critical to the success of the processing that all conditions of processing within such a processing environment be as close to identical as possible for all (three dimensional) points in the processing medium. This means that processing conditions must be close to identical not only in a radial direction for a processing chamber (that is typically cylindrical in shape) but must also be identical in a

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longitudinal or vertical direction of the processing chamber. Many conventional processing chambers have ports through which processing gasses are entered into the processing chamber and matching port from which spent gasses are extracted from the processing chamber. The very fact that these points of entry and exit are ports indicates that these are localized points of entry and exit, which further indicates that gasses that are released into a processing chamber enter this chamber at one point and are therefore typically not be equally distributed throughout the processing chamber. This than leads to differences in processing conditions within the processing chamber, a difference that readily leads to unequal processing results such as unequal formation of deposited layers or created device features. The method and apparatus of the invention addresses this concern and provides a method and apparatus where equal treatment of wafer surfaces for all wafers that are contained in a processing chamber can be approached.

Referring now specifically to Fig. 1, there is shown a cross section of a TEOS reaction chamber 15 wherein both the old and the new TEOS gas injectors are mounted.

The TEOS reaction chamber 15 has a number of gas entry ports, as follows:

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- 25 is the TEOS entry port, 10 is the TEOS entering through this port,
- 13 is an N_2 entry point, 14 is the N_2 entering through this point, and
- 23 is the O2 entry port, 16 is the O_2 entering through this port.

In addition, the following components of the TEOS reaction chamber are highlighted:

- 18 is the main container of the TEOS reaction chamber,
- 20 as stabilizer walls that stabilize the wafer boat during the time that the wafer boat is in the TEOS reaction chamber,
- 22 is the wafer boat (magazine) that contains the wafers while these wafers are in the TEOS reaction chamber. The wafer magazine is also used to load the wafers that need to be processed into the TEOS reaction chamber and to unload the processed wafers from the TEOS reaction chamber after the process of TEOS deposition and processing has been completed: The wafers that are contained in the wafer magazine are treated, from a logistics and processing point of view, as one batch of wafers that is processed in the TEOS reaction chamber,
- 24 is the new TEOS injector as it is mounted in the TEOS reaction chamber,

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- 25 is the entry port of the new TEOS injector 24 as it is mounted in the TEOS reaction chamber,
- 26 is the bottom or lower basin of the TEOS reaction chamber, and
- 28 is the exit port of the TEOS reaction chamber through which spent gasses are removed from the TEOS reaction chamber.

It is clear that the injector 24 of the invention provides for TEOS distribution along the upright or vertical dimension of the TEOS reaction chamber 15. This is clearly not the case for the conventional TEOS gas injector that releases the TEOS gas into the TEOS reaction chamber close to the bottom or lower basin 26 of the chamber without having any further means or method applied to the released TEOS gas (for even distribution throughout the TEOS reaction chamber) once the gas has entered into the TEOS reaction chamber. From this it is further clear that it is to be expected that the TEOS gas, after it enters into the TEOS reaction chamber, will have a TEOS gas density distribution that is far from uniform in a vertical direction of the TEOS reaction chamber. The TEOS gas, using the old injector, has a dense concentration close to the point of release of the gas into the TEOS reaction chamber, that is close to the bottom or lower basin 26 of the chamber. From this high TEOS concentration, the TEOS gas will through the process of diffusion be distributed

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throughout the TEOS reaction chamber but this distribution is not aided by any means other than the natural process of diffusion. Since this process of diffusion is very poorly defined and controlled, it cannot be expected that wafers (that are mounted in the wafer magazine 22 in a vertical direction of the TEOS reaction chamber) will be equally exposed to the TEOS gas after the gas has entered the TEOS reaction chamber. This process therefore leads to poor control of the TEOS deposition and processing cycle with correspondingly poor results of uniformity of deposition of the TEOS gate electrode spacers that are created using the TEOS reaction chamber.

For the reasons cited, the conventional method of TEOS gas distribution leads to poor performance of within wafer processing conditions. It is to be expected that the wafers which are close to the point of entry of the TEOS gas, that is wafers that are close to the bottom or lower basin 26 of the TEOS reaction chamber, will be more uniformly exposed to the TEOS gas than wafer that are further removed from this TEOS entry point. This is confirmed by measurements, which show that TEOS spacers that are created on the surface of a given wafer (within wafer) have a significantly more uniform range of thickness for wafers that are close to the bottom or lower basin 26 of the TEOS reaction chamber than is the case for wafers that are further removed from

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this lower basin 26. It is the objective of the invention to eliminate or as a minimum to sharply reduce this within wafer difference of created device features.

The TEOS injector of the invention, highlighted with 24 in the cross section that is shown in Fig. 2, assures significantly improved distribution of the TEOS gas prior to the release of the TEOS gas into the TEOS reaction chamber. The TEOS injector of the invention consists of a relatively long cylindrical tube into which openings have been created, the relatively long cylindrical tube is connected to a shorter cylindrical tube that allows for the longer section of the TEOS injector to be mounted inside the TEOS reaction chamber. This design of the TEOS injector allows for a significant improvement in the distribution of the released TEOS gas inside the TEOS reaction chamber. The TEOS injector of the invention is mounted inside the TEOS reaction chamber such that the central axis of the relatively long cylindrical tube of the TEOS injector of the invention is parallel to the vertical central axis of the TEOS reaction chamber. The TEOS gas that is entered into the TEOS reaction chamber via the new TEOS injector of the invention will, prior to its release into the TEOS reaction chamber, be distributed in the vertical direction of the TEOS reaction chamber and will therefore, upon release into the TEOS reaction chamber, be evenly distributed in a vertical

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direction of the TEOS reaction chamber. This even distribution of the TEOS gas inside the TEOS reaction chamber results in even and equal exposure (to the released TEOS gas) of the wafers that are contained in the wafer magazine 22 since these wafer are also distributed along the vertical direction of the TEOS reaction chamber. The new TEOS injector of the invention therefore provides TEOS to the surfaces of the wafers that are being processed under equal conditions of TEOS gas density, pressure, temperature and the like. The TEOS exposure and processing that is to occur to the wafers contained in the wafer magazine 22 will therefore be uniform for all the wafers that are contained in the wafer magazine 22. As a consequence, the gate electrode spacers that are formed as a result of the wafer processing have characteristics of deposition such as gate thickness that are uniform across each of the wafers that is contained in the wafer magazine 22, independent on the location of the wafers in a vertical direction of the TEOS reaction chamber.

Fig. 2a shows a side view of the conventional TEOS injector 30 which consists of the insertion section 31 and a TEOS gas release section 32. The insertion section 31 is the section that protrudes through the sidewall of the TEOS reaction chamber, the release section 32 is the somewhat narrower section that is

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mounted on the inside of the TEOS reaction chamber through which the TEOS gas enters the chamber.

Fig. 2b shows the TEOS injector of the invention which consists of the insertion section 36 and a TEOS gas release section 37. The insertion section 36 is the section that protrudes through the sidewall of the TEOS reaction chamber, the release section 37 is the section that is mounted on the inside of the TEOS reaction chamber through which the TEOS gas enters the chamber. Section 37 has been provided will multiple small openings around its circumference and in the longitudinal direction of section 37 (not shown), section 37 is the previously mentioned relatively long section of the TEOS injector of the invention that is mounted parallel with the central axis of the TEOS reaction chamber.

No actual dimensions of the conventional TEOS injector and the TEOS injector of the invention are discussed at this time since these dimensions are highly application dependent and are furthermore not germane to the essence of the invention.

Fig. 3 further confirms and illustrates the results that have been obtained with the TEOS injector of the invention. Fig. 3 shows in graphic depiction the uniformity and range of the TEOS

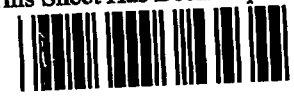
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thickness in forming TEOS spacers using the TEOS reaction chamber of Fig. 1, thereby including the TEOS injector of the invention as shown in Fig. 2b.

Fig. 3 shows test results that have been obtained relating to the process and apparatus of the invention. Along the horizontal or X-axis are presented the wafers in accordance with the stack or vertical position that these wafers occupy in the TEOS reaction chamber. The notation "a" represents wafer that are located furthest away from the bottom 26 of the TEOS reaction chamber, another way of stating this is that this wafer is at the top of the wafer stack contained within the wafer magazine 22 (Fig. 1). The notation "b" represents wafer that are located halfway between the top and the center of the stack, "c" represents a wafer that is located at the center of the stack, "d" represents wafer that are located halfway between the center and the bottom of the stack, "e" represents a wafer that is located at the bottom of the stack. The leftmost vertical or Y-axis plots the wafer-in-wafer uniformity in TEOS spacer thickness (in %) while the leftmost vertical axis plots the range (in Angstrom) of the TEOS spacer thickness. The vertical columns a1, b1, c1, d1 and e1 represent the range thickness of TEOS spacers that is measured for wafer that are processed in the TEOS reaction chamber using the old TEOS injector, the vertical

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columns a2, b2, c2, d2 and e2 represent the range thickness of TEOS spacers that is measured for wafer that are processed in the TEOS reaction chamber using the TEOS injector of the invention. In comparing the columns going from left to right (from columns "a" to columns "e", it is clear that the improvement in range are most dramatic for the wafers represented by column "a", that is form wafers that are located at the top of the stack while the improvement gradually decreases for wafers that are closer to the bottom of the stack. This is as to be expected since the TEOS injector of the invention brings the TEOS closer to the wafers at the top of the stack in a more controlled manner.

Uniformity of TEOS spacer deposition is further confirmed by curves "f" and "g" where curve "f" shows the uniformity of the deposited TEOS spacers using the conventional TEOS injector while curve "g" shows the uniformity of the deposited TEOS spacers using the TEOS injector of the invention. The observation that has been made regarding the range applies equally to the uniformity parameter, further confirming the value of the TEOS injector of the invention in creating TEOS spacers.

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The uniformity is calculated using the equation:

uniformity = (the range of thickness/ 2 x the mean of thickness) x 100%.

The indicated range is calculated using the equation:

range = maximum thickness - minimum thickness.

The above measurements are performed for nine points that are distributed along diagonals of the wafer, the diagonals intersect under a 90 degree angle. The intersect of the two diagonals is one of the nine points, the other eight points being equally spaced along the intersecting diagonals with two points located on each section of the intersecting diagonals. The outer points that are located on the diagonals and that are closest to the perimeter of the wafer are at a distance of 3 mm removed from the perimeter.

Although the invention has been described and illustrated with reference to specific illustrative embodiments thereof, it is not intended that the invention be limited to those illustrative embodiments. Those skilled in the art will recognize that variations and modifications can be made without departing from the spirit of the invention. It is therefore intended to include within the invention all such variations and

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modifications which fall within the scope of the appended claims and equivalents thereof.

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What is claimed is:

1. An L-shaped gas injector for injection of processing gasses into a cylindrical processing chamber, said cylindrical processing chamber having sidewalls, a bottom and a central axis, said central axis having a length within said processing chamber which extends between a point of entry and a point of exit of said central axis when passing through said cylinder processing chamber, said L-shaped injector comprising:

a first cylindrical section having a central axis, a length, a surface and a diameter;

a second cylindrical section having a central axis, a length, a surface and a diameter;

said central axis of said first section and said central axis of said first section fall in one plane and intersect under a first angle;

said length of said first cylindrical section is smaller than said length of said second cylindrical section by a measurable amount;

said first cylindrical section protrudes through said sidewalls of said processing chamber under a second angle;

said central axis of said second cylindrical section is parallel with said central axis of said processing chamber; and

a multiplicity of openings is provided in said surface of said second cylindrical section.

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2. The L-shaped gas injector of claim 1 wherein said processing gasses contain tetra-ethyl-ortho-silicate (TEOS).

3. The L-shaped gas injector of claim 1 wherein said processing chamber is a TEOS reaction chamber.

4. The L-shaped gas injector of claim 1 wherein said processing chamber is a reactor chamber where a reactive gasses can be introduced into said reactor chamber.

5. The L-shaped gas injector of claim 1 wherein said processing chamber is a reactor chamber where a reactive gasses can be introduced into said reactor chamber where in addition a dopant can be added to said reactive gasses.

6. The L-shaped gas injector of claim 1 wherein said processing chamber is a low pressure system.

7. The L-shaped gas injector of claim 1 wherein said processing chamber is a low pressure system with a SiC tube or quartz tube.

8. The L-shaped gas injector of claim 1 wherein said processing chamber is an Ion Metal Plasma (IMP) chamber.

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9. The L-shaped gas injector of claim 1 wherein said processing chamber is an LPCVD chamber.

10. The L-shaped gas injector of claim 1 wherein said first angle is ninety degrees.

11. The L-shaped gas injector of claim 1 wherein said second angle is ninety degrees.

12. The L-shaped gas injector of claim 1 wherein said first angle is between about 120 and 140 degrees.

13. The L-shaped gas injector of claim 1 wherein said second angle is between about 40 and 50 degrees.

14. The L-shaped gas injector of claim 1 wherein said openings provided in said surface of said second cylindrical section have a diameter and a central axis whereby said central axis of said openings intersects said surface of said second cylindrical under a third angle.

15. The L-shaped gas injector of claim 14 wherein said third angle is about 90 degrees.

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16. The L-shaped gas injector of claim 14 wherein said third angle is within a range from 90 to 90 ± 45 degrees.

17. The L-shaped gas injector of claim 14 wherein said diameter of said openings is smaller than said diameter of said second cylindrical section by a measurable amount.

18. The L-shaped gas injector of claim 1 wherein said second cylinder section has a length that about equals said length of said central axis of said cylinder processing chamber.

19. A method of applying a L-shaped gas injector for injection of processing gasses into a cylindrical processing chamber, said cylindrical processing chamber having sidewalls, a bottom and a central axis, said central axis having a length within said processing chamber which extends between a point of entry and a point of exit of said central axis when passing through said cylinder processing chamber, said L-shaped gas injector comprising:

a first cylindrical section having a central axis, a length, a surface and a diameter;

a second cylindrical section having a central axis, a length, a surface and a diameter;

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said central axis of said first section and said central axis of said first section fall in one plane and intersect under a first angle;

said length of said first cylindrical section is smaller than said length of said second cylindrical section by a measurable amount;

said first cylindrical section protrudes through said sidewalls of said processing chamber under a second angle;

said central axis of said second cylindrical section is parallel with said central axis of said processing chamber; and

a multiplicity of openings is provided in said surface of said second cylindrical section.

20. The method of claim 19 wherein said processing gasses contain tetra-ethyl-ortho-silicate (TEOS).

21. The method of claim 19 wherein said processing chamber is a TEOS reaction chamber.

22. The method of claim 19 wherein said processing chamber is a reactor chamber where a reactive gasses can be introduced into said reactor chamber.

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23. The method of claim 19 wherein said processing chamber is a reactor chamber where a reactive gasses can be introduced into said reactor chamber where in addition a dopant can be added to said reactive gasses.

24. The method of claim 19 wherein said processing chamber is a low pressure system.

25. The method of claim 19 wherein said processing chamber is a low pressure system with a SiC tube or quartz tube.

26. The method of claim 19 wherein said processing chamber is an Ion Metal Plasma (IMP) chamber.

27. The method of claim 19 wherein said processing chamber is an LPCVD chamber.

28. The method of claim 19 wherein said processing chamber is a thermal oxidation furnace.

29. The method of claim 19 wherein said processing chamber is a thermal diffusion furnace.

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30. The method of claim 19 wherein said processing chamber is a high atmospheric pressure oxidation furnace.

31. The method of claim 19 wherein said processing chamber is a plasma operated oxidation furnace.

32. The method of claim 19 wherein said first angle is ninety degrees.

33. The method of claim 19 wherein said second angle is ninety degrees.

34. The method of claim 19 wherein said first angle is between about 120 and 140 degrees.

35. The method of claim 19 wherein said second angle is between about 40° and 50 degrees.

36. The method of claim 19 wherein said openings provided in said surface of said second cylindrical section have a diameter and a central axis whereby said central axis of said openings intersects said surface of said second cylindrical under a third angle.

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37. The method of claim 36 wherein said third angle is about 90 degrees.

38. The method of claim 36 wherein said third angle is within a range from 90 to 90 ± 45 degrees.

39. The method of claim 36 wherein said diameter of said openings is smaller than said diameter of said second cylindrical section by a measurable amount.

40. The method of claim 19 wherein said second cylinder section has a length that about equals said length of said central axis of said cylinder processing chamber.

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